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CASE REPORT

Musculoskeletal Sonography Facilitates the Diagnosis of Adolescent Acute Tibial Tubercle Cortical Avulsion Fracture

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Acute tibial tubercle cortical avulsion fracture is not common. We describe a 13-year-old boy with a mild limp and swelling pain in the left lower knee after a fall. Physical examination revealed local tenderness and swelling over the left tibial tubercle. Initial left knee radiographs revealed a small linear indistinct radiopaque shadow anterior to the tibial tubercle. Musculoskeletal sonography disclosed a small displaced fragment over the anterior portion of the left tibial tubercle and a smaller partially detached fragment over the anterior portion of the left anterior proximal tibial metaphysis. Cortical avulsion fracture was suspected; the diagnosis was confirmed after taking a right knee radiograph for comparison. The patient gradually recovered after conservative treatment.

Musculoskeletal ultrasound is a useful screening tool and can be used to facilitate diagnosis.
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Introduction

Acute tibial tubercle avulsion fracture is uncommon [1,2], accounting for less than 3% of all epiphyseal injuries [2] and with most of the cases involving adolescent boys. The fracture may result from acute flexion of the knee against the contracted quadriceps while making a bad landing at the end of a jump or violent contraction of the quadriceps during extension [1,2]. Radiographic findings can be used to

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establish the diagnosis of acute tibial tubercle avulsion fracture; however, radiography might not provide sufficient information about the extent of the fracture and soft-tissue injuries. Musculoskeletal sonography has been shown to be an effective imaging tool in sports medicine [3] and is ideal for initial examination of periarticular swelling [4].

We report on a 13-year-old boy with an acute tibial cortical avulsion fracture, which was diagnosed with the help of sonography.

Case report

A 13-year-old boy with no previous knee discomfort felt pain in the inferior aspect of the left knee after a fall from the bed to the ground while the knee was flexed; the pain was accompanied by mild swelling and limping. The symptoms subsided after application of an ice pack, so the patient returned to ordinary exercise the next day. However, the pain recurred and could be relieved with application of an ice pack. He exercised as usual at school in the following days, and the pain relapsed. He was brought to our rehabilitation outpatient department 7 days later. Physical examination revealed local tenderness and swelling over the left tibial tubercle area. The initial radiography of the left knee showed a small, indistinct, linear radiopaque shadow anterior to the tibial tubercle (Fig. 1) and a tibial tubercle cortical avulsion fracture was suspected. Because the cross-sectional extent of injury could not be clearly demonstrated on anteroposterior radiograph,

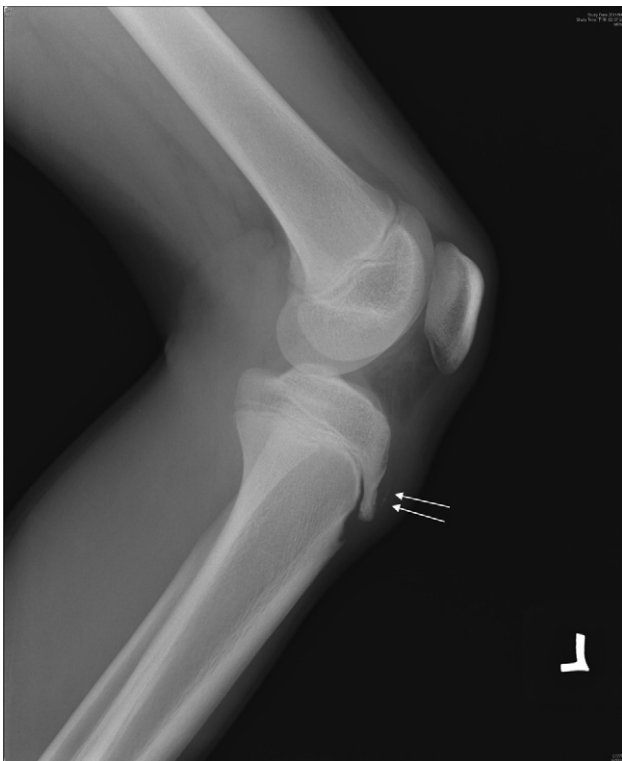


Fig. 1 Lateral radiograph of the left knee shows a small linear indistinct radiopaque shadow (double arrow) anterior to the apophysis of the tibial tubercle.

sonography of left knee was performed immediately. Sonography revealed a small, displaced fragment in the middle area of the apophysis of the tibial tubercle, thickening and mildly hypoechoic change in the patellar tendon, thickening of the cartilage overlying the apophysis of the tibial tubercle, and mild cortical disruption over the anterior portion of the proximal tibial metaphysis (Figs. 2 and 3). Tibial tubercle cortical avulsion fracture was suspected, and the diagnosis was confirmed after taking a right knee radiograph for comparison. The patient was referred to the orthopedic division on the same day and received conservative treatment. His symptoms relieved completely after 2 months, and he returned to normal activity.

Discussion

Anteroposterior and lateral radiographs of the proximal tibia are essential to confirm the diagnosis of an acute tibial tubercle avulsion fracture [5]. In this patient, a lateral radiograph of the left knee showed a small, indistinct, linear radiopaque shadow anterior to the tibial tubercle with swelling of the overlying soft tissue, and a tibial tubercle cortical avulsion fracture was suspected initially. However, the injury of cross-sectional extent and adjacent soft tissue could not be clearly identified on the anteroposterior radiograph. Ultrasound is ideal for initial examination of periarticular swellings and tendon disorders [4], and it revealed a small displaced fragment in the central area of the apophysis of the tibial tubercle and thickening and hypoechoic change of the cartilage overlying the ossification center, and mild cortical disruption over the anterior portion of the proximal tibia. No obvious increased gap between the detached fragments and tibial tubercle could be detected during dynamic ultrasound. However, no obvious hyperemia could be found, likely because of the effect of the ice pack used just before the patient was brought to hospital.

The small, indistinct, linear radiopaque shadow anterior to the tibial tubercle on the lateral radiograph of the left knee was also likened to an ossification center or intratendinous calcification of patellar tendon. The presence of an ossification center was ruled out after comparing with sonography of the right knee; intratendinous calcification was also ruled out because the detachment fragment was beneath the cartilage and fit the defect of left tibial tubercle well on sonography.

Patients with acute tibial tubercle avulsion fractures often experienced immediate pain rendering them unable to stand and often treated with closed reduction or open reduction and internal fixation [6]. This patient sustained an acute tibial tubercle cortical avulsion fracture; however, it was not compatible with any type of tibial tubercle avulsion fracture as classified by Watson-Jones [7]; in addition, his symptoms were relatively mild in comparison with other types of acute tibial tubercle fractures, so conservative treatment was chosen. The patient finally made a full recovery.

We conclude that musculoskeletal sonography is a useful screening tool and can be used to facilitate the diagnosis of acute tibial tubercle cortical avulsion fracture.

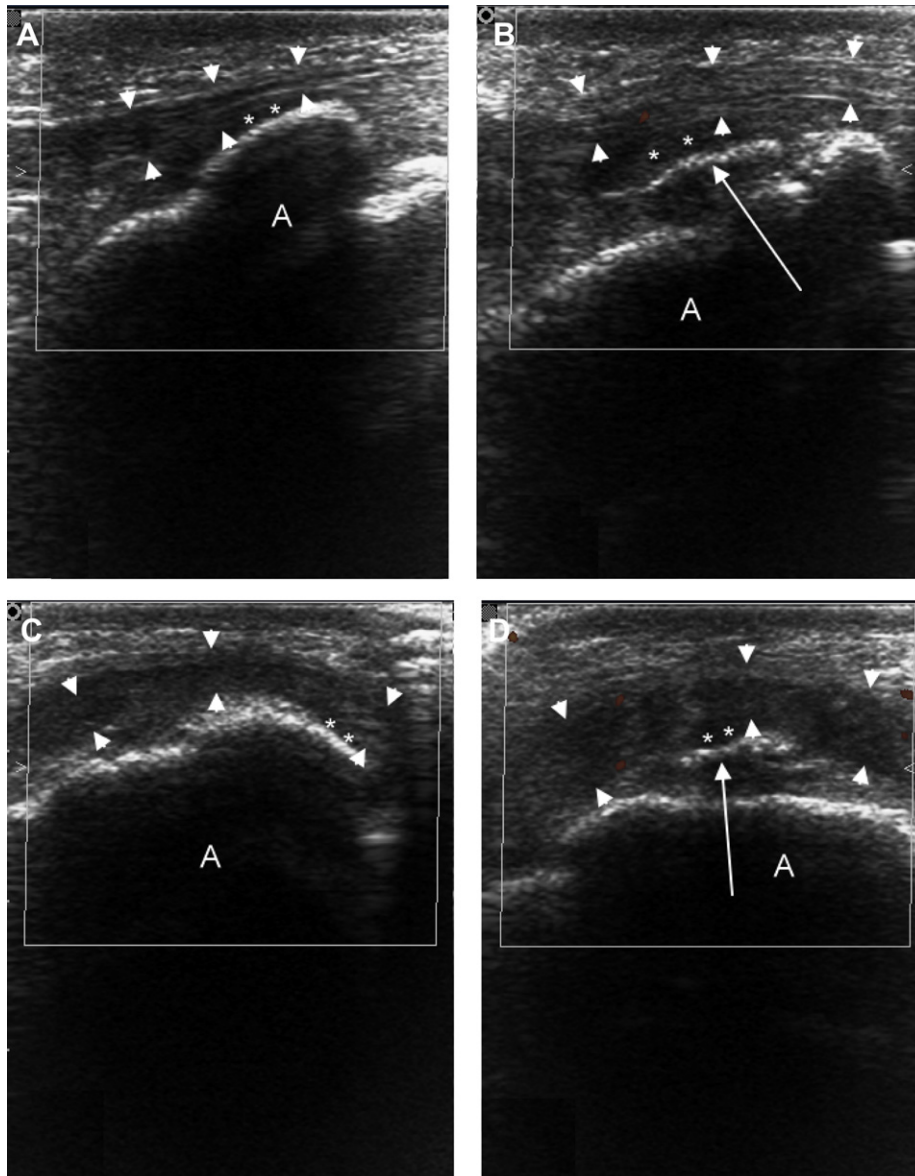


Fig. 2 Sonography of the proximal ossified part of the tibial tubercle. (A) Longitudinal and (C) transverse scans through the right side, asymptomatic. (B) Longitudinal and (D) transverse scans through the left side, symptomatic. Sonographic features of an asymptomatic anterior tibial tubercle apophysis show patellar tendon and cartilage of the apophysis of the tibial tubercle. Sonography of the symptomatic anterior tibial tubercle apophysis shows a small displaced osseous fragment in the middle area of the apophysis of the tibial tubercle (arrow), thickening and mild hypoechogenicity of the distal patellar tendon (arrowhead), and thickening of the cartilage (asterisk) overlying the apophysis of the tibial tubercle. A = apophysis.

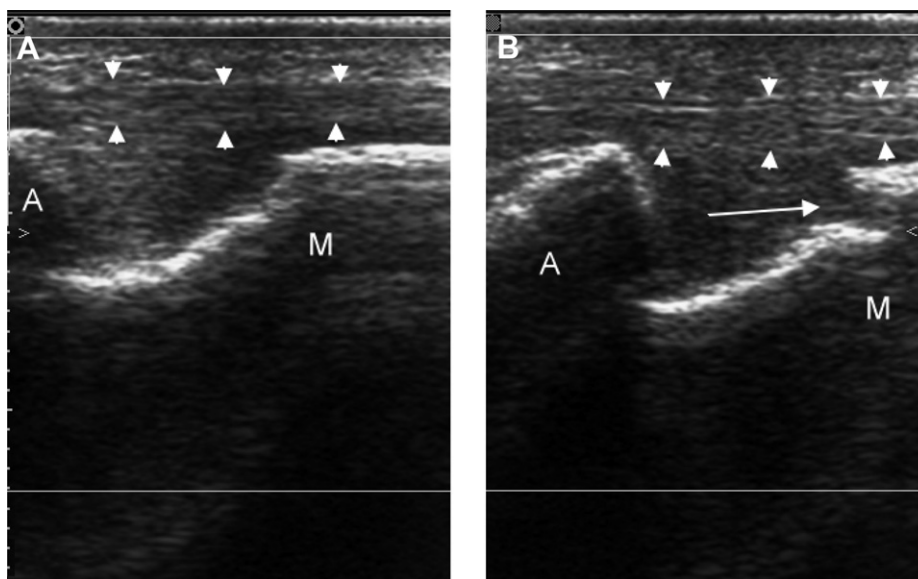


Fig. 3 Longitudinal scan through the distal nonossified part of the tibial tubercle apophysis. (A) Right side, asymptomatic. (B) Left side, symptomatic. Sonography of the asymptomatic tibial tubercle apophysis disclosed patellar ligament attached to the apophysis of the tibial tubercle and anterior portion of the proximal tibial metaphysis. Sonography of the symptomatic tibial tubercle apophysis revealed mild cortical disruption over the anterior portion of the proximal tibial metaphysis (arrow) over the anterior portion of the proximal tibial metaphysis of the left knee. (Note: The scale bars in Figs. 2 and 3 are different.) A = apophysis; M = metaphysis.

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